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IC CHIP CARRIER TAPE AND ITS MANUFACTURING METHOD
[IC chippu you kyariateepu oyobi sono seizouhouhou]

Yoshio Hamano

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INVENTOR	(72):	HAMANO, YOSHIO
APPLICANT	(71):	SUMITOMO BAKELITE CO., LTD.
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[Claims] /2*

[Claim 1] IC chip carrier tape formed by carrier tape pieces, each of which contains multiple IC chip storage cavities that each has locking sticks erected at the four corners, being fitted and welded one after another to the rear ends of carrier tape pieces in a mutually complementary manner.

[Claim 2] IC chip carrier tape defined in Claim 1, wherein slits are made in the four corners of the outer circumferences of the IC chip storage cavity.

[Claim 3] IC chip carrier tape defined in Claim 1 or 2, wherein locking claws are provided to the locking sticks.

[Claim 4] A manufacturing method for IC chip carrier tape characterized by: utilizing a mold that contains multiple molding spaces which are arranged at constant intervals for the formation of cavities having four locking sticks erected at the four corners, that has at the front-end part a molding space that matches the shape of the carrier tape's cross-section, and that has at the rear-end part a molding space having a partially missing shape that will allow the connecting part to be fitted in a mutually complementary manner; injecting a melted resin into the molding spaces to form a first carrier tape piece after closing the mold which can be separated vertically and then cooling [the carrier tape piece] down; subsequently opening the mold and moving the first carrier tape piece from the mold as far as the length of the carrier tape piece to set the partially missing end formed at the rear end of the first carrier

* Numbers in the margin indicate pagination in the foreign text.

tape piece inside the front end of the mold; injecting the melted resin into the mold after closing the mold; forming a second carrier tape piece while injecting the melted resin in a mutually complementary manner into the missing parts of the partially missing end of the previously formed carrier tape piece; opening the mold after cooling [the carrier tape piece] down; moving the second carrier tape piece in the same manner as the first carrier tape piece; forming a third carrier tape piece by the same procedure; and sequentially repeating this procedure.

[Detailed Description of the Invention]

[0001] [Technical Field of the Invention]

The present invention relates to IC chip carrier tape utilized for automatic mounting of IC chips onto electronic products.

[0002] [Related Art of the Invention]

Automatic mounting of IC chips has already been conventionally carried out by means of a loading robot. In that case, many IC chips are stored in cavities provided in a single row or multiple rows in carrier tape, the IC chips are fed to the vicinities of the electronic products to which they should be mounted, and each of the IC chips stored in the carrier tape becomes automatically mounted to the predetermined position of the corresponding electronic product by means of a robot arm that operates swiftly. According to this method, long band-like resin-made tape that has cavities that match the shapes of the IC chips is utilized. However, resin-made carrier tape has horizontal plays at the positions of the IC chips in the IC chip storage cavities, and [the IC chips] are not precisely fixed to set positions of the IC chip storage cavities.

There is also the risk that the lead wires become deformed by hitting the walls of the IC chip storage cavities. These lead to problems in the automatic mounting process or the need for cover tape. To prevent these, it is necessary to carry out packaging by fixing the resin mold part of the IC chip to the interior of the IC chip storage cavity and by lifting the lead wires of the IC chip from the bottom. This requires a structure in which the resin mold part of the IC chip is firmly pressed against the bottom, but it is impossible to form sheets of conventional resin-made IC chip carrier tape by means of vacuum or pressure forming.

[0003] [Problems that the Invention is to Solve]

The aim of the present invention is to supply IC chip carrier tape that makes it possible for IC chips to be fixed to IC chip storage cavities accurately and securely and to be accurately and automatically loaded into the cavities by retaining the resin mold parts.

[0004] [Means for Solving the Problems]

The present inventor focused on the fact that conventional resin-made IC chip carrier tape causes a play at the position of each IC chip because of the facts that the dimensions of an IC chip storage cavity include the allowance provided for the distance between one end and the other end of each lead wire protruding from the IC chip and also that the resin mold part of the IC chip is not secured. In light of this, the inventor thought it was necessary to secure the molding part of the IC chip in the anteroposterior, horizontal, and vertical directions by means of locking sticks or such. Since such locking sticks cannot be formed in IC chip storage cavities by means of vacuum or pressure forming, which

is utilized for conventional carrier tape, injection molding was selected for the manufacture. Injection molding has a shortcoming in that the molding is discontinuous, but this shortcoming was overcome by the discovery that continuous molding can be accomplished by using the unique shape of band-shaped tape, and this invention was completed as a result. In other words, the present inventions supplies IC chip carrier tape that is formed by carrier tape pieces, each of which contains multiple IC chip storage cavities that each has locking sticks erected at the four corners, being fitted and welded one after another to the rear ends of carrier tape pieces in a mutually complementary manner. [The invention also supplies] a manufacturing method for IC chip carrier tape characterized by: utilizing a mold that contains multiple molding spaces which are arranged at constant intervals for the formation of cavities having four locking sticks erected at the four corners, that has at the front-end part a molding space that matches the shape of the carrier tape's cross-section, and that has at the rear-end part a molding space having a partially missing shape that will allow the connecting part to be fitted in a mutually complementary manner; injecting a melted resin into the molding spaces to form a first carrier tape piece after closing the mold which can be separated vertically and then cooling [the carrier tape piece] down; subsequently opening the mold and moving the first carrier tape piece from the mold as far as the length of the carrier tape piece to set the partially missing end formed at the rear end of the first carrier tape piece inside the front end of the mold; injecting the melted resin into the mold after closing the mold; forming a second carrier tape piece

while injecting the melted resin in a mutually complementary manner into the missing parts of the partially missing end of the previously formed carrier tape piece; opening the mold after cooling [the carrier tape piece] down; moving the second carrier tape piece in the same manner as the first carrier tape piece; forming a third carrier tape piece by the same procedure; and sequentially repeating this procedure. /3

[0005] As the resin utilized for the IC chip carrier tape of the invention, it is possible to use, in addition to resins conventionally used for IC chip carrier tape such as polystyrene and polypropylene, heat-resistant resins and resins that do not become deformed when heated at normal baking temperatures (i.e. 125 - 200°C), examples of which include single resins such as polypropylene, polycarbonate, PPO, PBT, PPS, PES, etc. and [resins] that are, in order to improve heat resistance, combined with 30 - 80% by weight of inorganic fine powder of talc, mica, etc. or with 20 - 50% by weight of a fibrous filler such as glass fiber, carbon fiber, whiskers, etc.. These heat-resistant resins and filler-combined resin compositions can be made to have the heat-deforming temperature of 120°C or higher. To prevent electrification, the resins can be combined with appropriate amounts of metal oxide, such as carbon black, SnO_2, In_2O_3, etc. or metal powders thereof. Locking sticks are set up erect at the four corners inside each of the IC chip storage cavities of the carrier tape of the invention, and claws extend from the front ends of these locking sticks toward the center of the IC chip storage cavity and can secure the four corners of the IC chip by holding them down. These locking sticks are positioned at intervals that roughly match the square dimensions of

an IC chip so that, when an IC chip is pushed in from the top, the four locking sticks become spread open and allow the IC chip to be inserted. After the insertion, the restoring forces of the locking sticks allow the resin mold of the IC chip to be secured by the claws equipped at the front ends of the locking sticks. The lower surface of the IC chip is supported by a seat provided at the bottom of the IC chip storage cavity. The sandwiching force between the seat and the locking sticks secures the IC chip and prevents the lead wires of the IC chip from contacting the bottom or side faces too forcefully. According to the manufacturing method of the invention, long, band-shaped carrier tape is manufactured by successively welding and connecting a carrier tape piece of a certain length, which is one of the carrier tape pieces being injection-molded one after another, to the end of a carrier tape piece that has been injection-molded to the certain length.

[0006] The manufacturing method of the invention is characterized by connecting the rear end of a molded carrier tape piece to the front end of the next carrier tape piece by sandwiching it inside the front end of a mold and pouring a melted resin into the area of the rear end of the carrier tape piece. Then, the rear end of the previous carrier tape is provided with a missing part, and by injecting a melted resin into this missing part, the connecting part becomes welded and fixed at the time of injection molding. Because of the thin, band-like shape, it is easy to adjust [the tape's] temperature. Therefore, by adjusting the conditions, it is possible to swiftly finish the injection molding of the next melted resin before the rear end of the previously formed carrier

tape becomes melted by the heat of the melted resin and to immediately cool and fix it. Even if the rear end becomes melted slightly, restricting the shape of the previously formed rear end by using the front end of the mold that has an extra extending length prevents the cross-sectional shape and vertical length of the band-like connecting part from being altered. This connecting part can be formed by adjusting the temperature of the melted resin injected to the connecting part as well as the post-resin-injection cooling rate of the connecting part. The mold employed for the manufacturing method of the invention has inner surfaces that allow for the formation of multiple IC chip storage cavities having spaces that each contains locking sticks erected at the four corners. The mold also has inner surfaces that form the cross-sectional shape of a carrier tape piece at the front end and that provide the tape with a missing part at the rear end. The first carrier tape piece is formed by means of this mold, the mold is then cooled down and opened, and the carrier tape is moved by the length of the first carrier tape piece. At this time, the connecting part is missing from the shape of the rear end of the first carrier tape piece. This rear end of the carrier tape piece is sandwiched inside the front end of the same mold, which is then closed and has a melted resin injected into it to be molded. Since the front end of the mold has the normal tape shape, the melted resin enters the missing part at the rear end of the previously formed carrier tape piece during the formation of the front end of the next carrier tape piece, and the two ends can be easily connected by means of welding.

[0007] In terms of production efficiency, it is preferable to set

up a plurality, specifically about three to ten, of the molds utilized for the manufacturing method of the invention for carrier tape pieces and to produce as long a carrier tape piece as possible during each injection molding. Moreover, it is desirable in terms of efficiency to set up multiple production lines, e.g. three to five lines, and to carry out simultaneous injection molding by using many molds. Each mold used for the injection molding should desirably have at least one resin injection line for each IC chip storage cavity. From the perspective of strengthening the connecting part, it is particularly desirable to install an injection line at the connecting part of the front end of the mold. The injection lines can be provided with an insulating structure by a common procedure. The carrier tape of the invention is obtained by connecting multiple carrier tape pieces, and each connecting part consists of the ends of two carrier tape pieces that are fitted to each other in a manner such that they mutually complement the missing shapes to complete the shape of the tape. The shape of the rear end of a molded carrier tape piece may have parts that are missing in a two-dimensional manner when viewed from the vertical direction, may have parts that are missing when viewed from the side of the carrier tape piece, or may have the combination of the two. In either case, the bonding of the fitted parts is strong because they are welded by using a resin of the same quality, and the flexibility is hardly altered by the connecting structure. Therefore, the strength should be sufficient as long as the missing parts occupy a certain surface area. However, to make the connecting part as strong as the tape part between IC chip storage cavities, it is desirable that

the missing parts be shaped in a manner such that the front ends of the carrier tape pieces become wedged into each other as illustrated in Figure 1 or Figure 3.

[0008] [Embodiment of the Invention]

The present invention will be explained in further detail with reference to drawings illustrating an embodiment of the invention. Figure 1 is a plan view illustrating the structure of the rear end of the carrier tape piece of the embodiment of the invention. As in this figure, when the carrier tape piece is inserted into the front end of a mold up to the a-a line, which is at the rear end of the carrier tape piece, and a melted resin is injected after the mold has been closed, the melted resin enters the missing parts K of the rear end of the carrier tape /4 piece. Cooling it down and subsequently extracting it will reveal that connecting structures that are mutually fitted in a complementary manner have been formed as illustrated in Figure 2. In this case, the distance between the IC chip storage cavities via the connecting part accurately matches the distance between [any other two neighboring] IC chip storage cavities. The mutually complementary connecting structures that can be used for the carrier tape of the invention vary, and it is even permissible to utilize a structure in which the upper layer of the tape is missing as illustrated in Figure 3. The IC chip storage cavities pertaining to the embodiment of the invention are illustrated in the plan view of Figure 4 and in the cross-sectional views of Figure 5 and Figure 6. With reference to Figure 4, there are four seats 5 on which an IC chip is to be mounted at the bottom 1 of the IC chip storage cavity, and the center of the bottom

1 has a hole 7 for an extrusion pin, which is utilized to remove the IC chip by pushing it out. Four locking sticks 2 are erected at the four corners inside the IC chip storage cavity, and their front ends have claws 3 that are extended toward the center. On the inner side, there are mold pin holes 8 made by the pins extended from the lower mold and necessary for the formation of the locking sticks 2. The seats 5 of this IC chip storage cavity can support the lower surface of the resin mold part of the IC chip. When an IC chip is pushed toward these seats 5, the upper part of the locking sticks 2 spread open, and when the IC chip reaches the seats, the restoring forces of the locking sticks 2 secure the four corners of the IC chip in the spaces between the claws 3 of the locking sticks 2 and the seats 5. As for the condition of the locking sticks 2 and the corners 9 of the IC chip, the claws 3 of the locking sticks fix the IC chip by holding down the slanted surfaces of the mold resin [of the IC chip] as illustrated in Figure 7. Since the locking sticks 2 are provided at the corners of the IC chip storage cavity, they do not block the lead wires protruding vertically from the sides of the IC chip.

[0009] The mold pin holes 8 on the inner sides of the locking sticks 3 illustrated in Figure 7 are created as a result of the vertically erect pins passing through them from the lower mold, and the claws at the front ends of the locking sticks 2 cannot be formed by a vertically split mold if the lower mold does not have these pins. Slits 4 that penetrate to the front and rear are provided on the outsides of the four corners of each IC chip storage cavity of the IC chip carrier tape of this embodiment. These slits improve the bendability of the IC chip carrier tape and make

it easy to be reeled. It also prevents the winding [of the tape] caused by the reeling from affecting the IC chip storage cavity. The mold used in this embodiment is a split mold that can be separated vertically. When closed, the shape of the middle part of the closed space consists of the shapes of five IC chip storage cavities arranged at fixed intervals as well as the shape of tape that connects each of the IC chip storage cavities, the front-end part consists of the shape of tape that connects each IC chip storage cavity, and the rear-end part consists of the shape of tape that is partially missing. Each of the IC chip storage cavities of this mold is provided with a resin injection line, and each resin injection line has a heat insulating function. In particular, it is possible to inject a temperature-controlled melted resin into the front-end part.

[0010] [Effects of the Invention]

Since the IC chip carrier tape of the invention can secure IC chips at the accurate positions, automatic mounting of IC chips can be carried out accurately. Moreover, the manufacturing method for IC chip carrier tape of the invention enables the production of long IC chip carrier tape by means of injection molding.

[Brief Description of the Drawings]

[Figure 1] Figure 1 is a plan view of the connecting end of an IC chip carrier tape piece pertaining to the embodiment of the invention.

[Figure 2] Figure 2 is a plan view illustrating the connected condition of the IC chip carrier tape piece pertaining to the embodiment of the invention.

[Figure 3] Figure 3 is a cross-sectional view illustrating the

connecting end of another mode of the embodiment of the invention.

[Figure 4] Figure 4 is a plan view of the IC chip carrier tape pertaining to the embodiment of the invention.

[Figure 5] Figure 5 is a cross-sectional view along the vertical center line of the IC chip storage cavity of Figure 4.

[Figure 6] Figure 6 is a cross-sectional view along the b-b line of the IC chip storage cavity of Figure 4.

[Figure 7] Figure 7 is a cross-sectional view illustrating the condition in which an IC chip has been inserted and fixed in the cross-sectional view along the c-c line of the IC chip storage cavity of Figure 4.

[Explanation of the Reference Numerals]

1 = bottom

2 = locking stick

3 = claw

4 = external slit

5 = seat

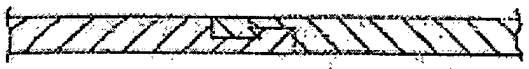
6 = pitch hole

7 = hole for extrusion pin

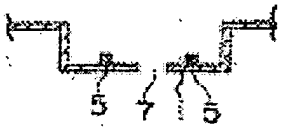
8 = mold pin hole

9 = corner of IC chip

[Figure 3]



[Figure 5]



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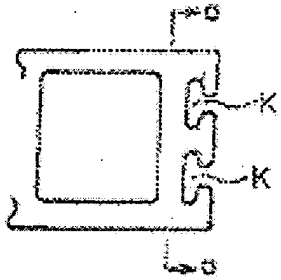
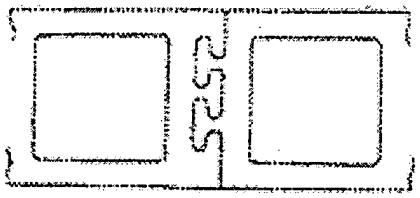
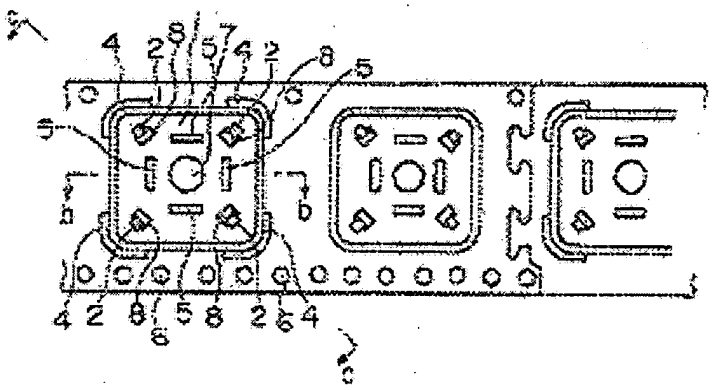
[Figure 1]



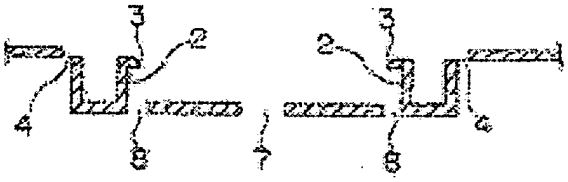
[Figure 2]



[Figure 4]



[Figure 6]



[Figure 7]